

Council Conservation Resource Potential Assessment and Cost-Effectiveness Methodology

Tom Eckman
Manager, Conservation Resources

Bonneville "Brown Bag" On I-937
March 26, 2008



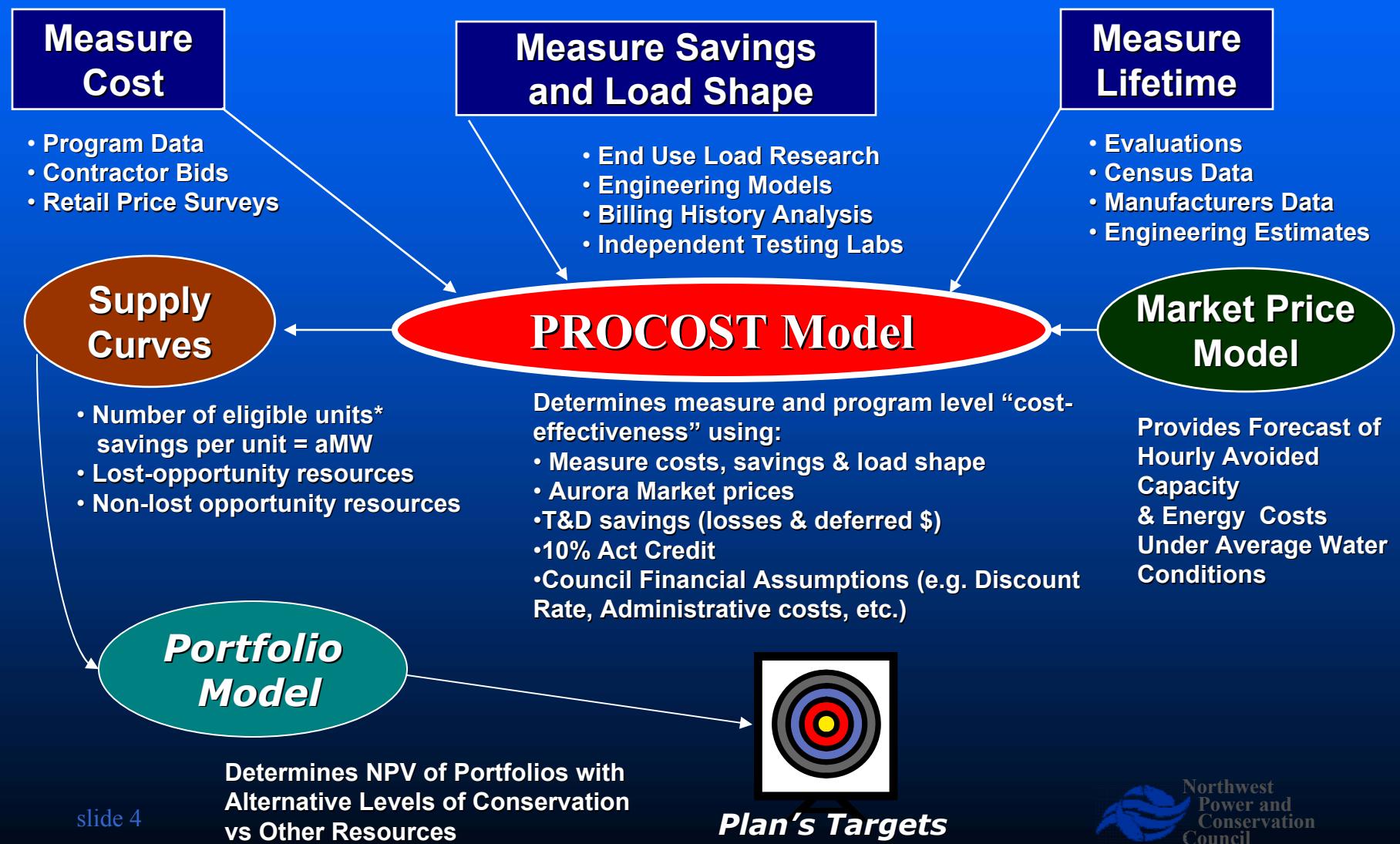
Overview of Methodology

- Resource Potentials Assessment
 - Determines technical availability, achievable potential & cost
- IRP Analysis
 - Determines cost-effectiveness level and “targets”
 - Compares all resources
 - Develops low-cost resources first
 - Results in resource acquisition plans
 - » Targets & budgets & programs for conservation

Source for Methodology

- Regional Act
 - and Council interpretation of the Act
- Bottom line
 - Develop cost-effective resources first
- Defines cost-effective conservation
 - “...estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative measure or resource...”

Generic Methodology for Estimating Conservation Resource Potential & Targets



Inputs to Resource Potentials Assessment Methodology

■ Availability

- Scope of measures
 - » Technologies
 - » Practices
- Applicability territory
 - » Number of units
 - » Units savings
- Achievable over time
 - » Retrofit
 - » Lost-Opportunity

■ Costs

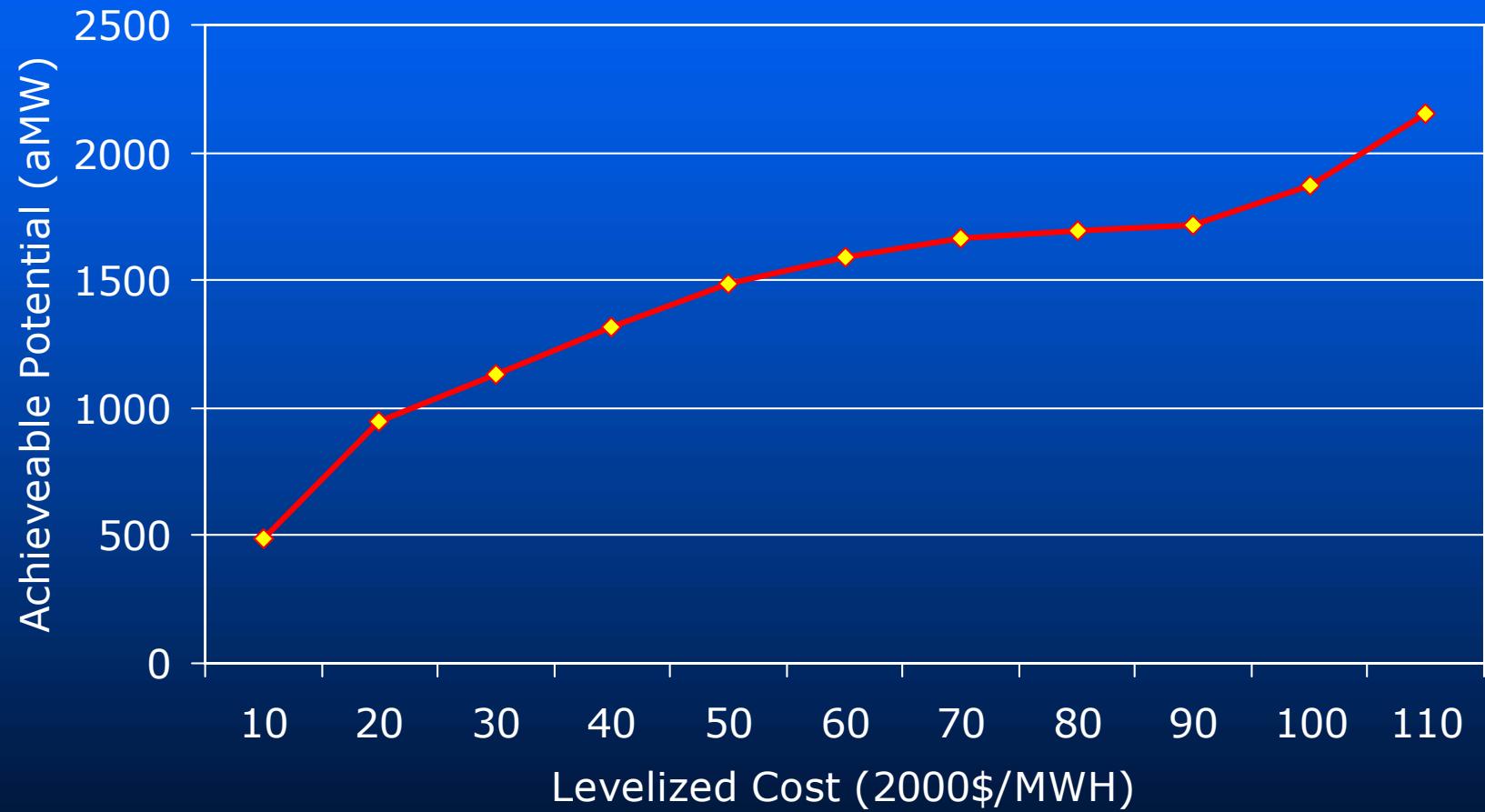
- Materials & labor
- Annual O&M
- Periodic Replacement
- Program Admin
- Financing costs
- Externalities
- Other non-electric

Results of Resource Potential Assessment Methodology

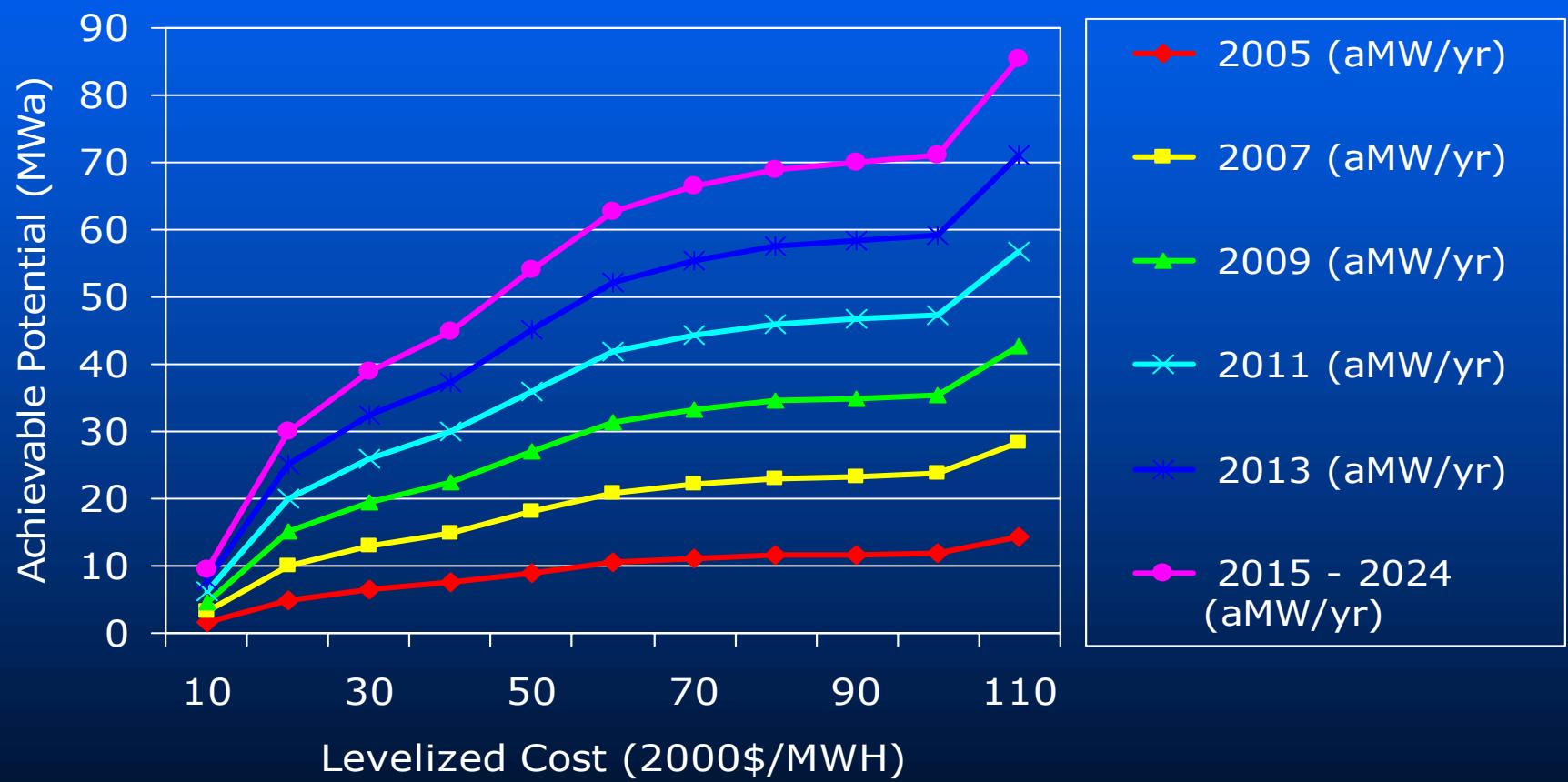
- Summarize availability & cost
 - Supply Curves
 - TRC levelized costs
 - » All Costs (net of benefits) per kWh
 - Lost-Opportunity Supply Curve
 - Retrofit Supply Curve (Non-Lost-Op)
 - Availability timeline
- Apples to apples comparison



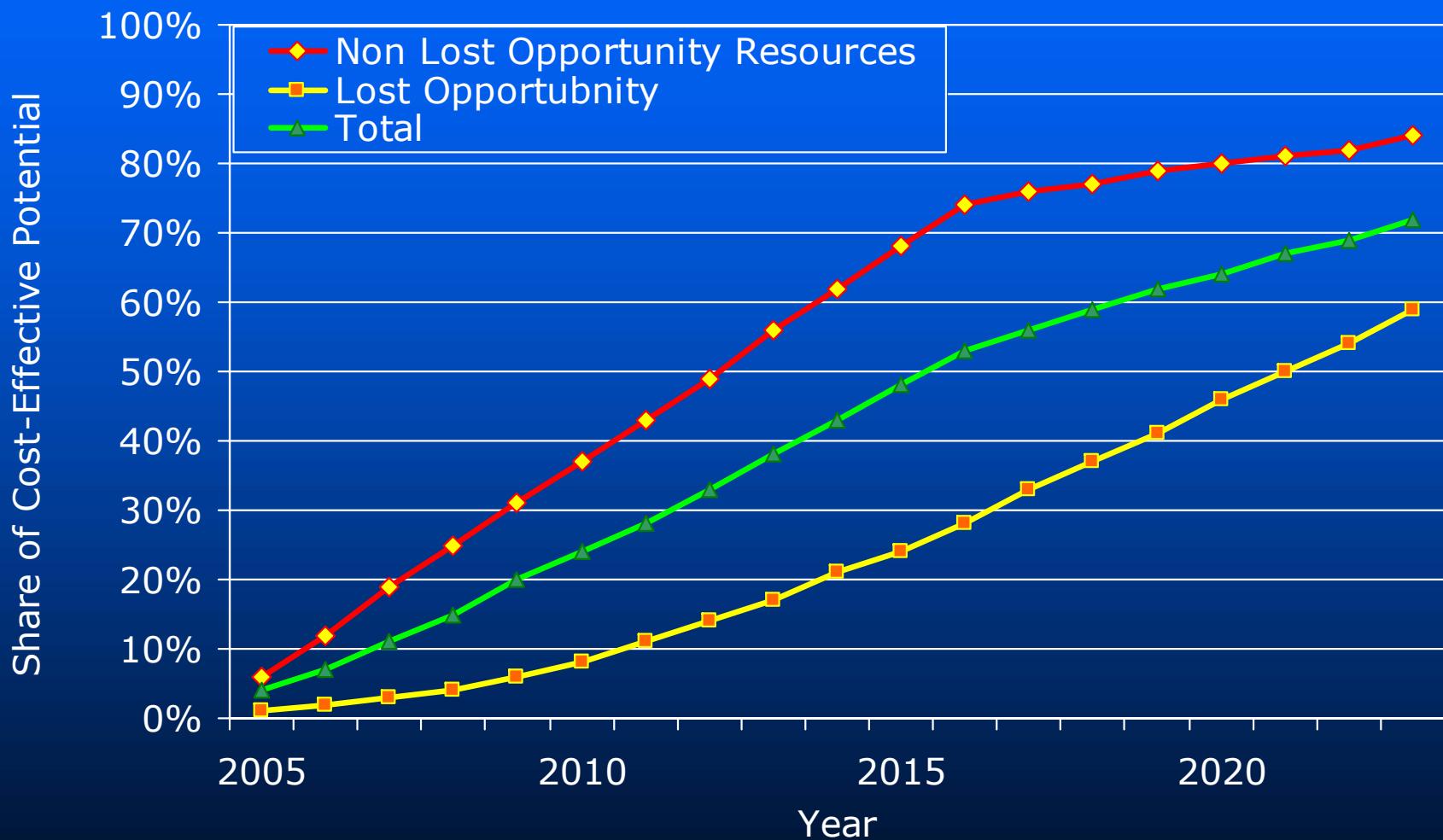
5th Plan's Non Lost-Opportunity Supply Curve



5th Plan's Lost-Opportunity Supply Curves



5th Plan's Achievable Potential



IRP Methodology

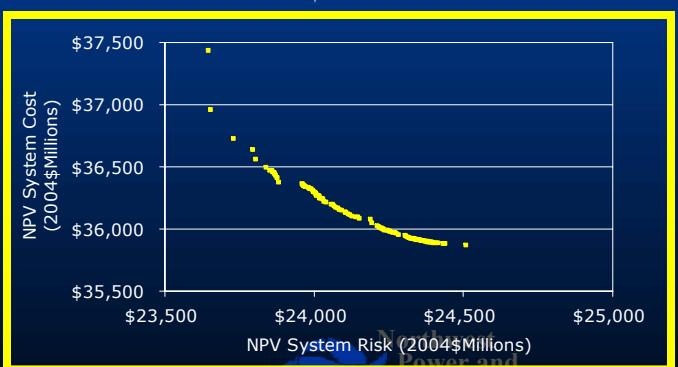
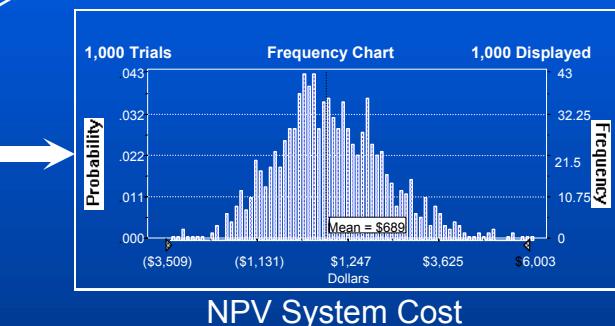
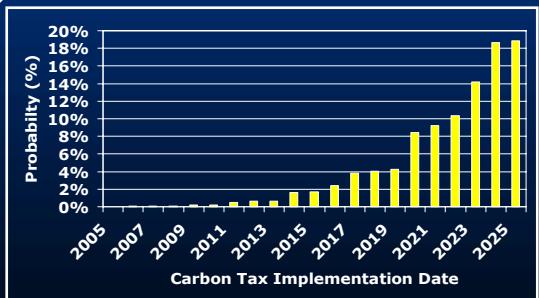
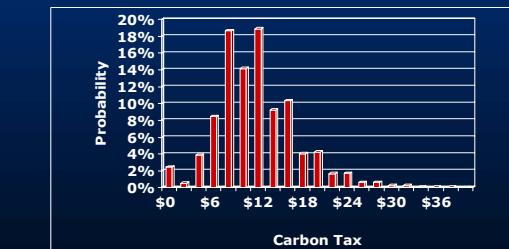
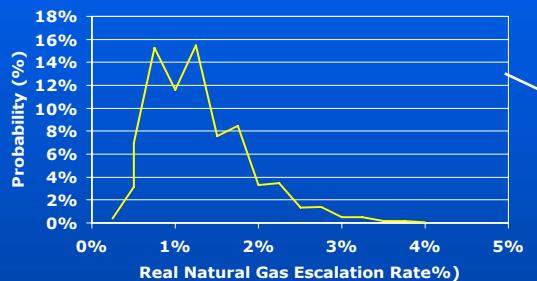
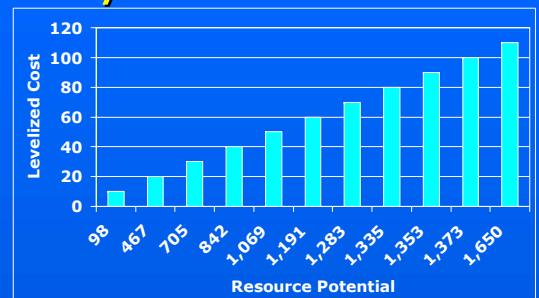
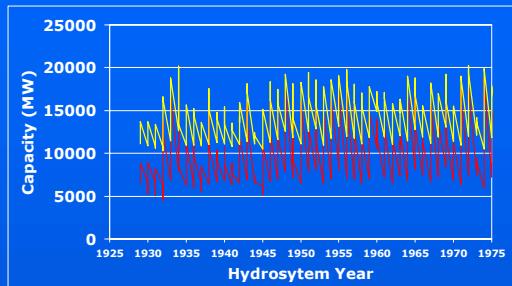
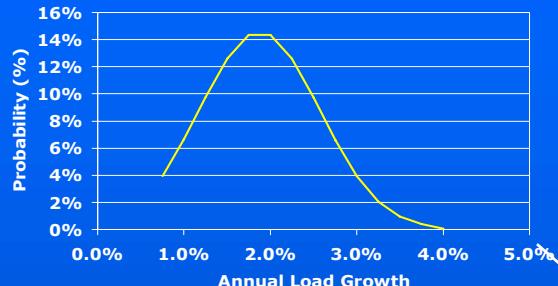
- Supply Curves delivered to Portfolio Model
- Portfolio Model finds least cost & risk Plans
 - Plan is resource acquisition & option schedule
 - Includes both conservation & generation
 - Amounts & timing of acquisitions & options
- For conservation this includes
 - » Lost-Opportunity schedule
 - » Non-Lost-Opportunity schedule
 - » A Cost-effectiveness threshold

Conservation
Program
Implementation

IRP Methodology

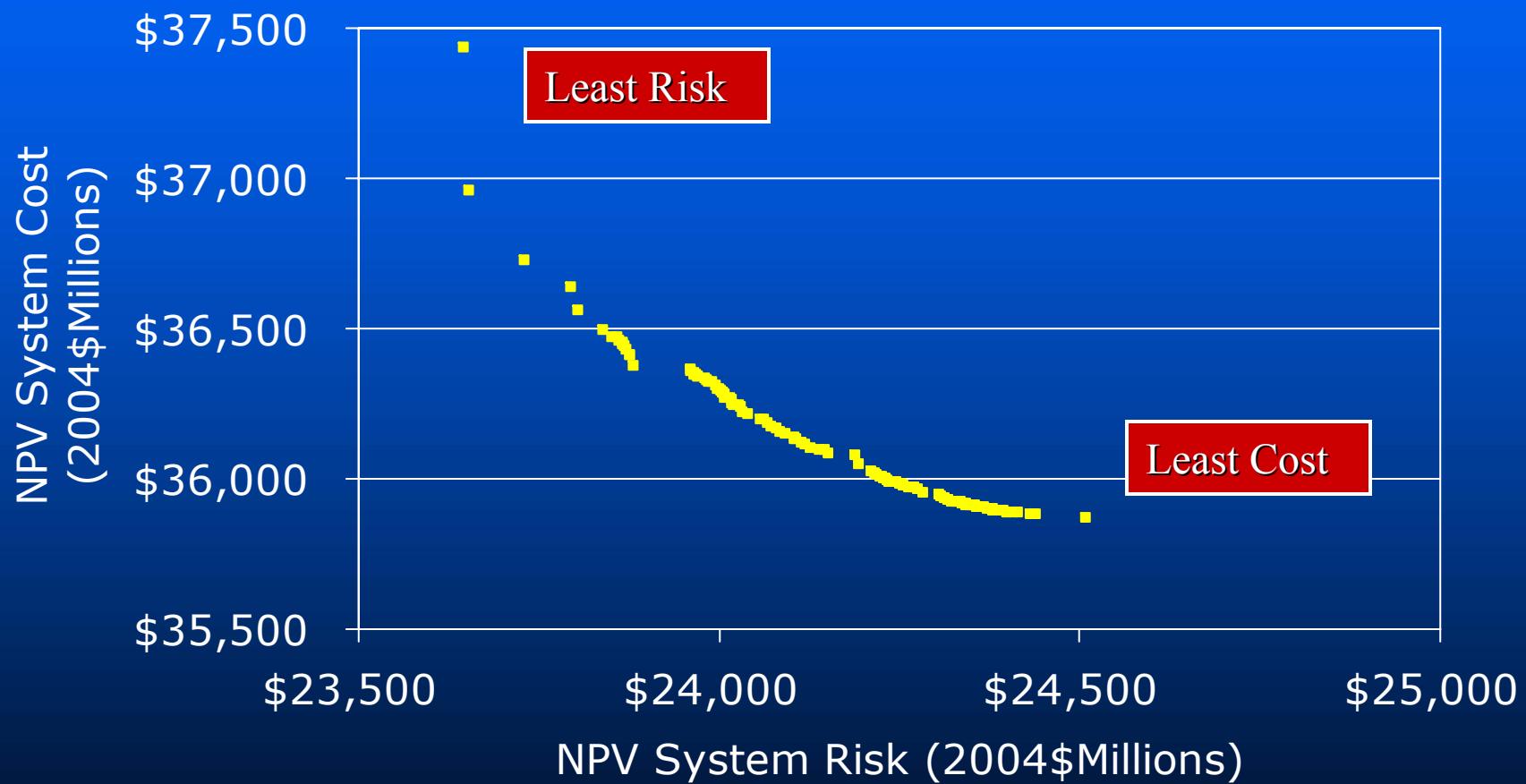
- 5th Plan tested hundreds of Plans
- Against 750 futures
- Found Plans with low cost & risk
- Tested Alternative Conservation Deployment Schedules
- Regional Conservation Targets
 - Derived from Plans on low-cost low-risk front

Portfolio Analysis Determines How Much Energy Efficiency to Develop in the Face of Uncertainty



Efficient Frontier

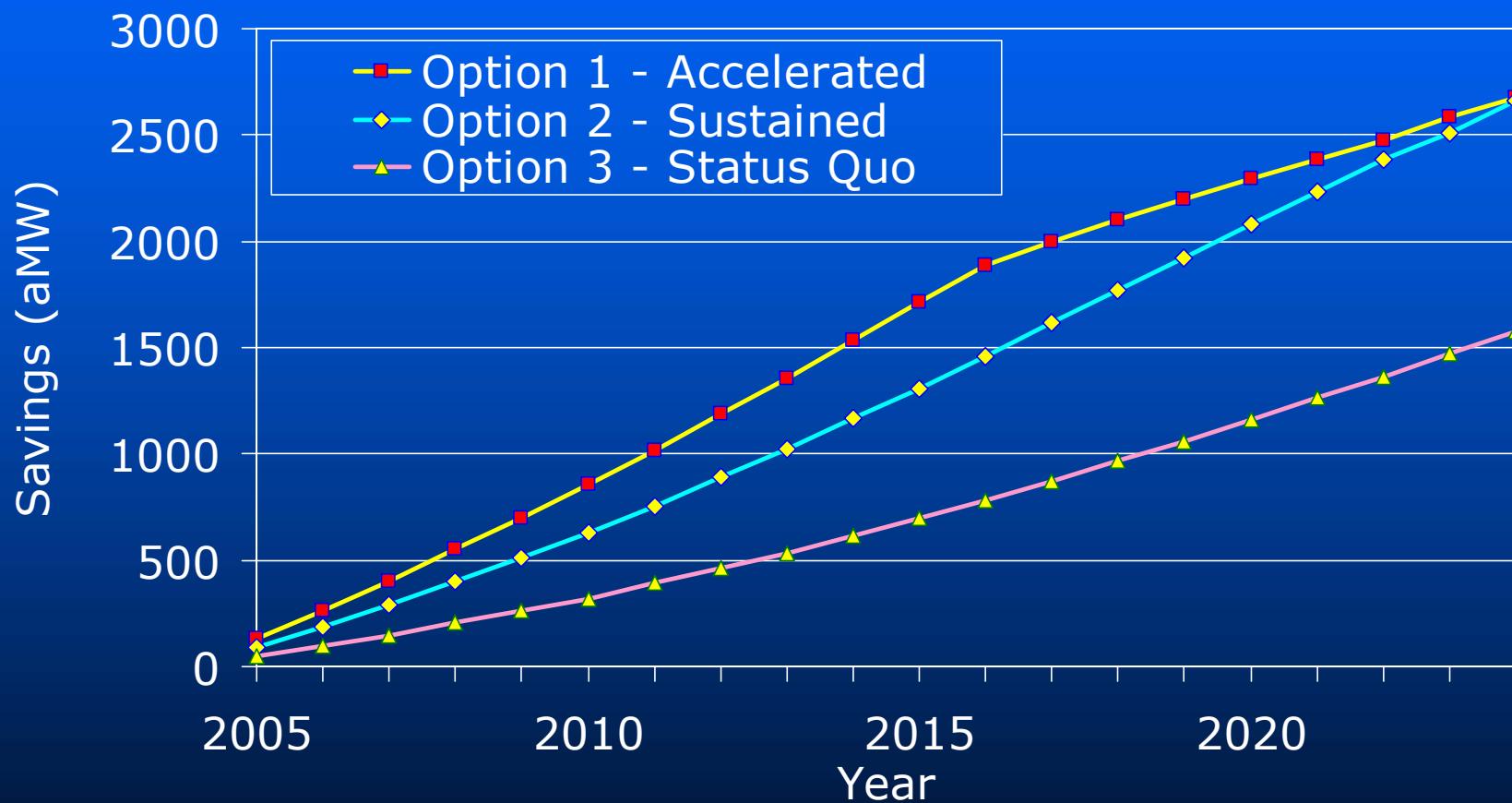
Plans Along the Efficient Frontier Permit Trade-Offs of Costs Against Risk



Annual Conservation Acquisitions in 5th Plan



Pace of Conservation Deployment Matters



Or . . .

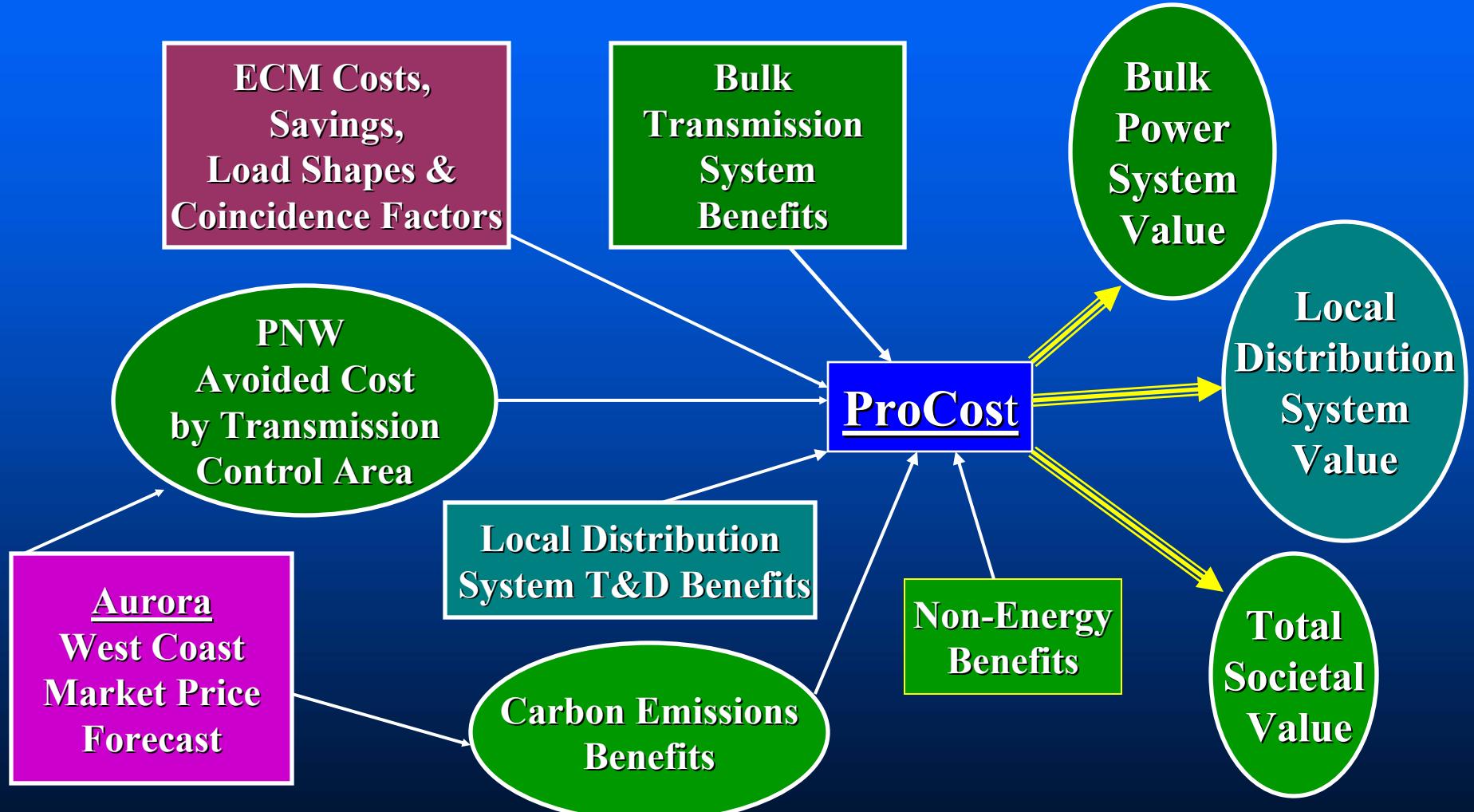
Utilities Can Just Use the Utility Target Calculator

[http://www.nwcouncil.org/energy/
UtilityTargetCalc_v1_3.xls](http://www.nwcouncil.org/energy/UtilityTargetCalc_v1_3.xls)

Background Slides

Regional Act Cost-Effectiveness

Conservation Measure Cost-Effectiveness “Inputs and Outputs”



What's A kWh Saved Worth?

- Value of a kWh of savings depends
 - Cost of power in the wholesale market during the time of day, day of week, month of the year and the year it is saved
 - How many years it lasts

Plus ... Other Values of Conservation

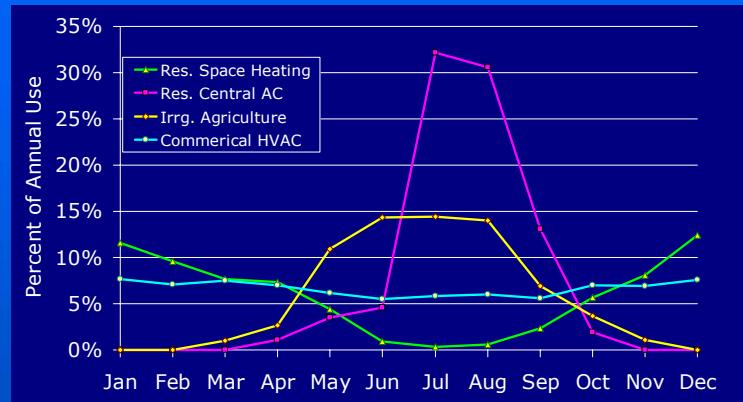
- Quantifiable Non-Energy Benefits
 - Water savings, maintenance labor
- Distribution system expansion deferral
 - Poles, wires, transformers, substations
- Transmission system expansion deferral
 - Bigger poles & wires
- Externalities: Like CO2 production
- Regional Act Credit of 10% to conservation

Why Value Conservation at Wholesale Market Prices?

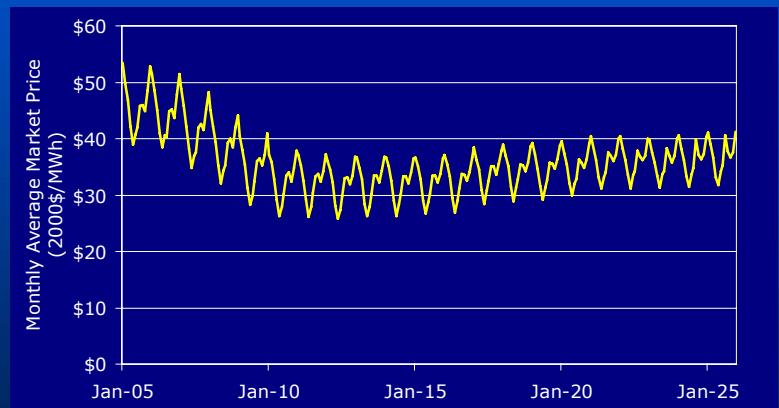
- Price paid to buy or sell the marginal kWh, or “run” the marginal resource
- At any given time, the marginal resource may or may not be a new power plant
- Conservation often displaces older generation out of the region
- Conservation defers new coal, wind, solar and gas generation

Timing-Based Value

Shape of Savings



Value of Wholesale Power



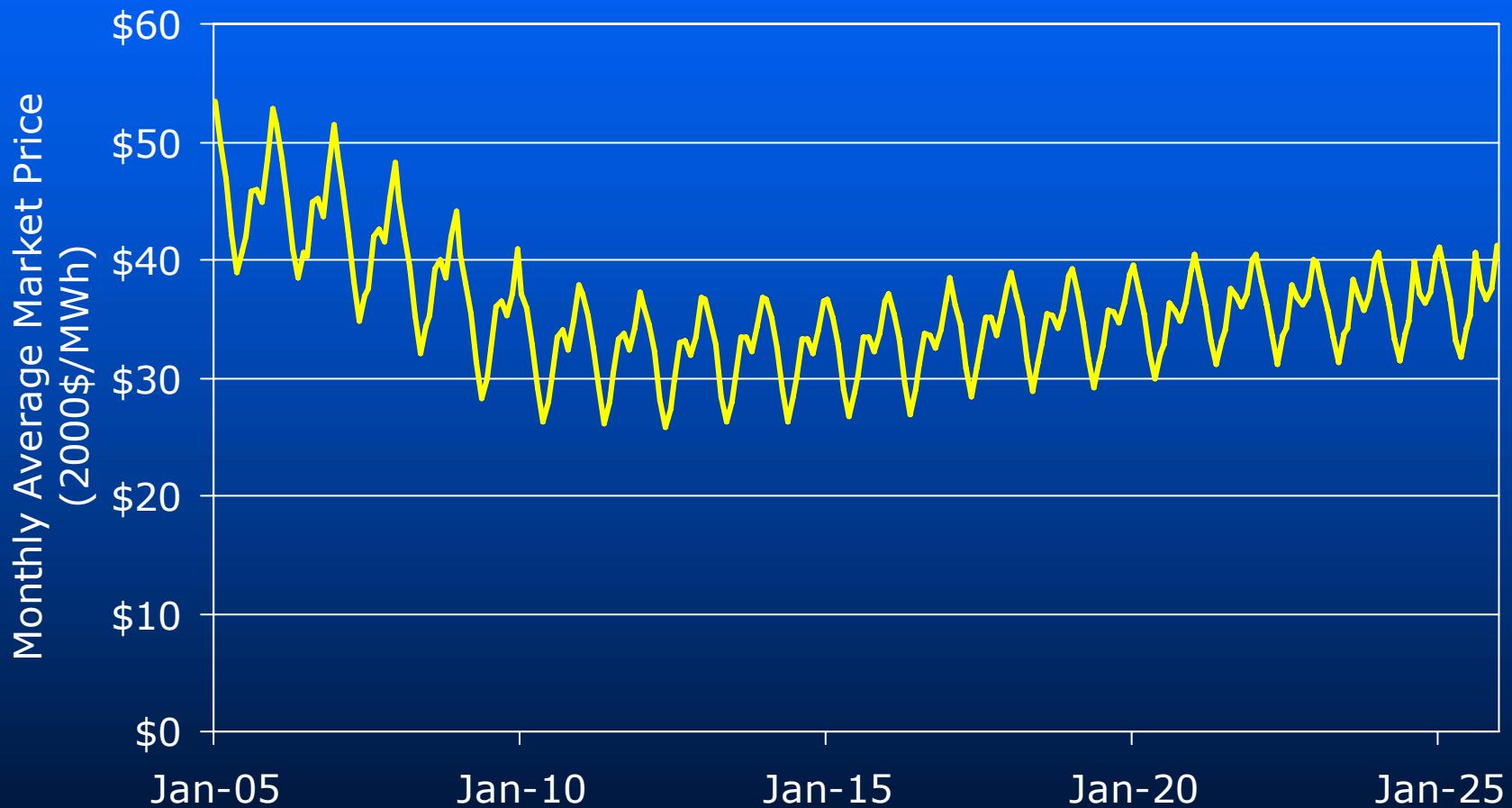
Value of kWh Saved



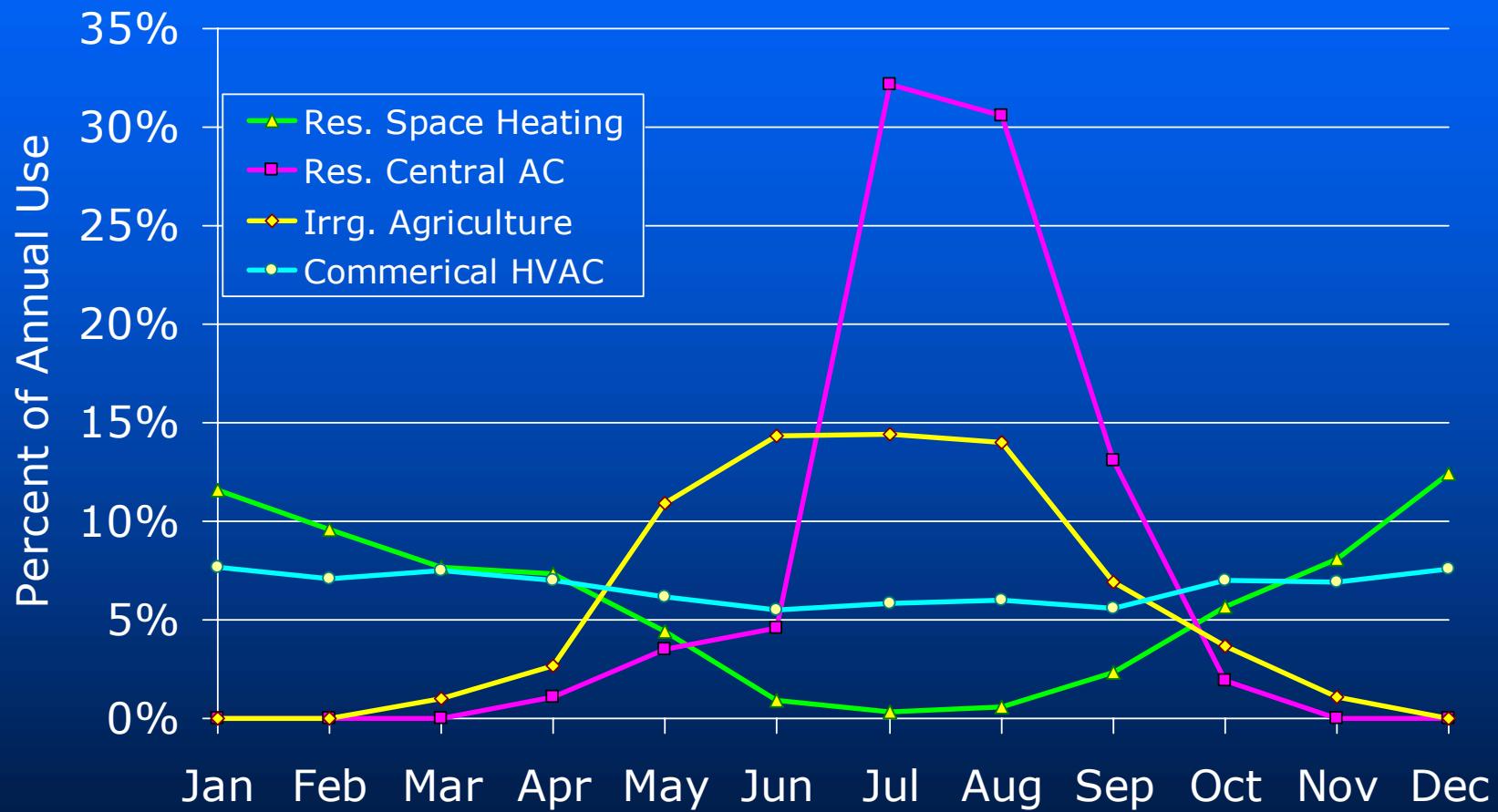
\$



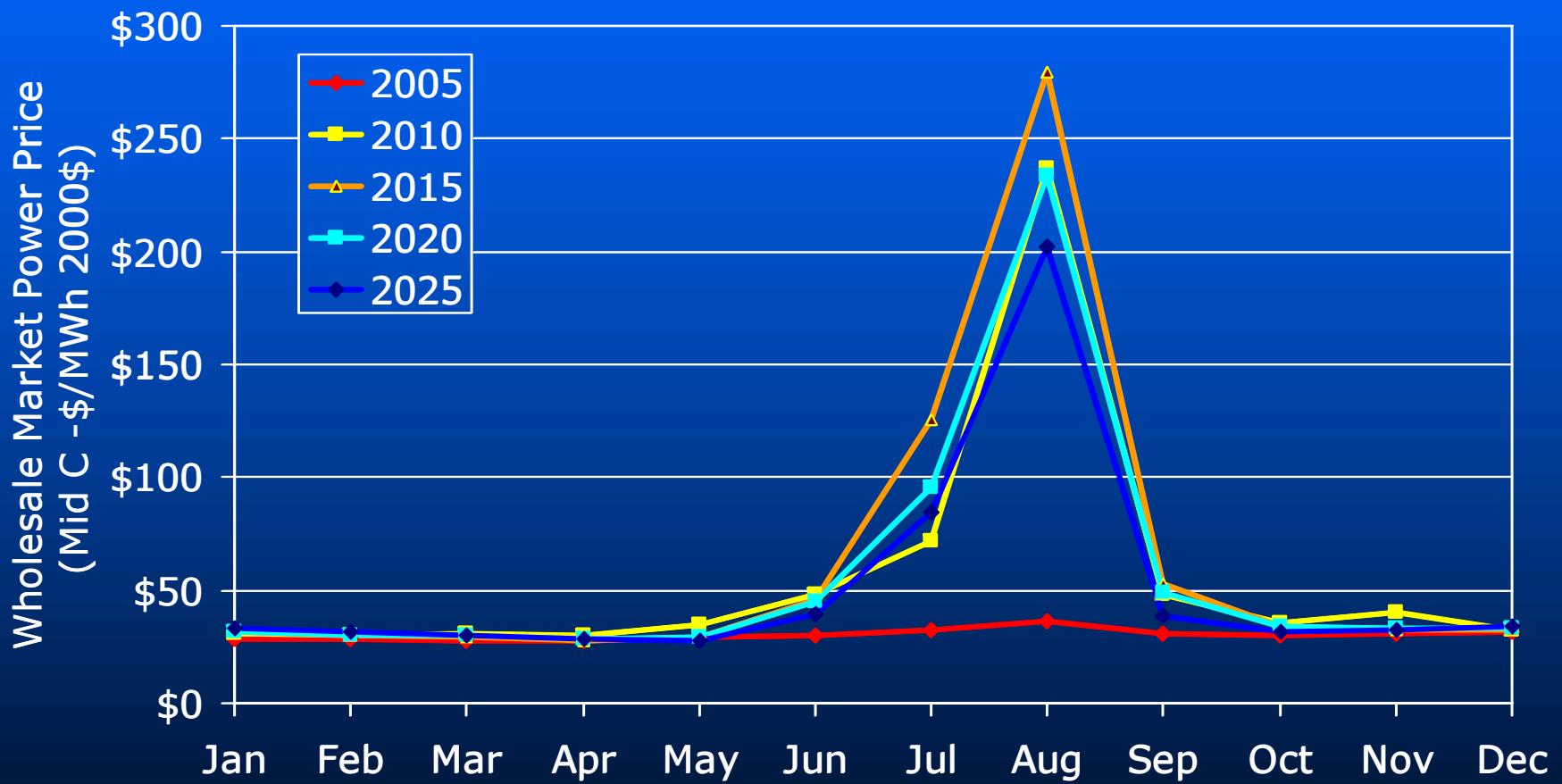
Council 5th Plan Forecast of Future Average Monthly Market Prices (Mid C-Trading Hub)



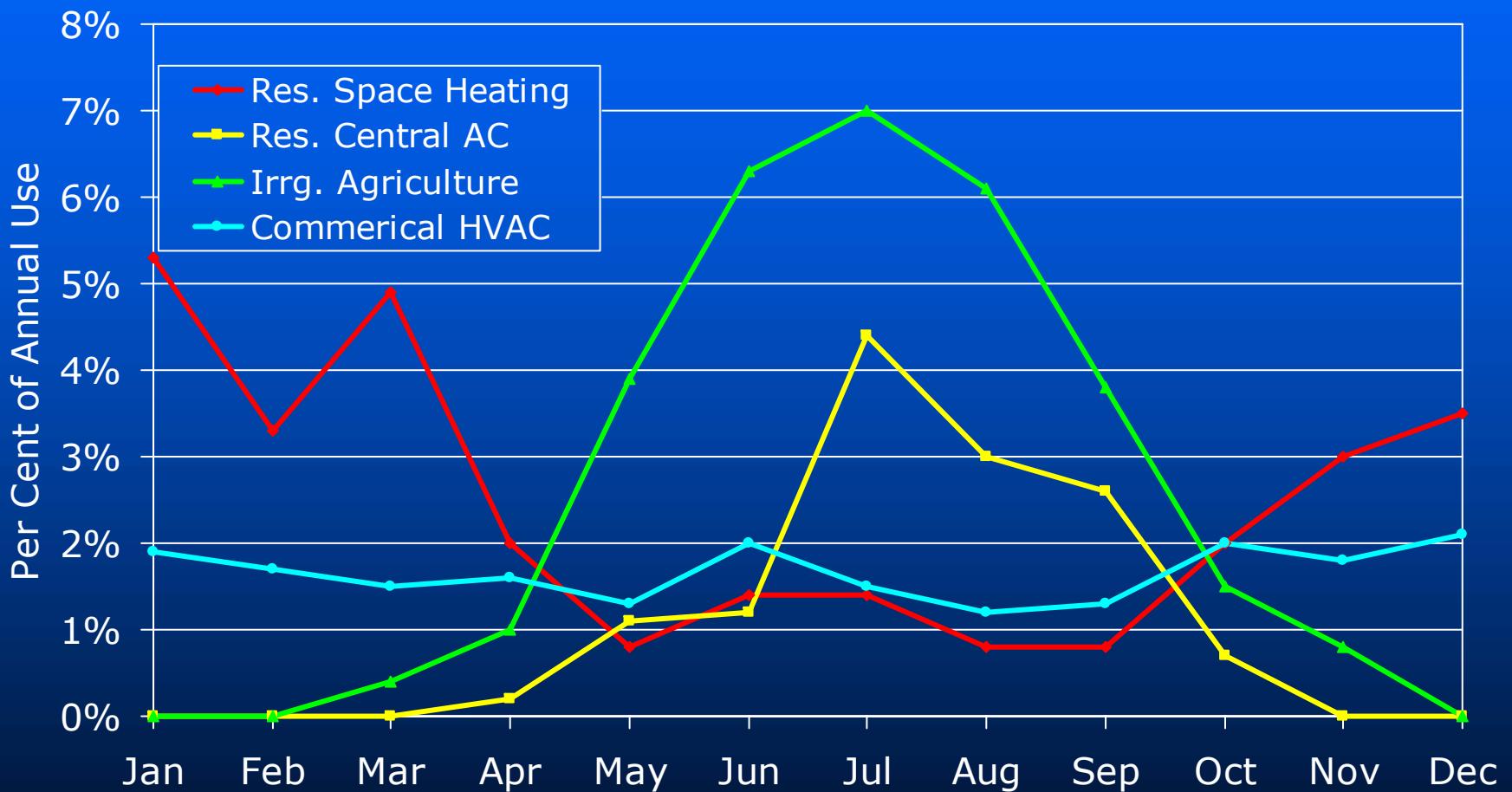
Typical “On-Peak” Load Profiles



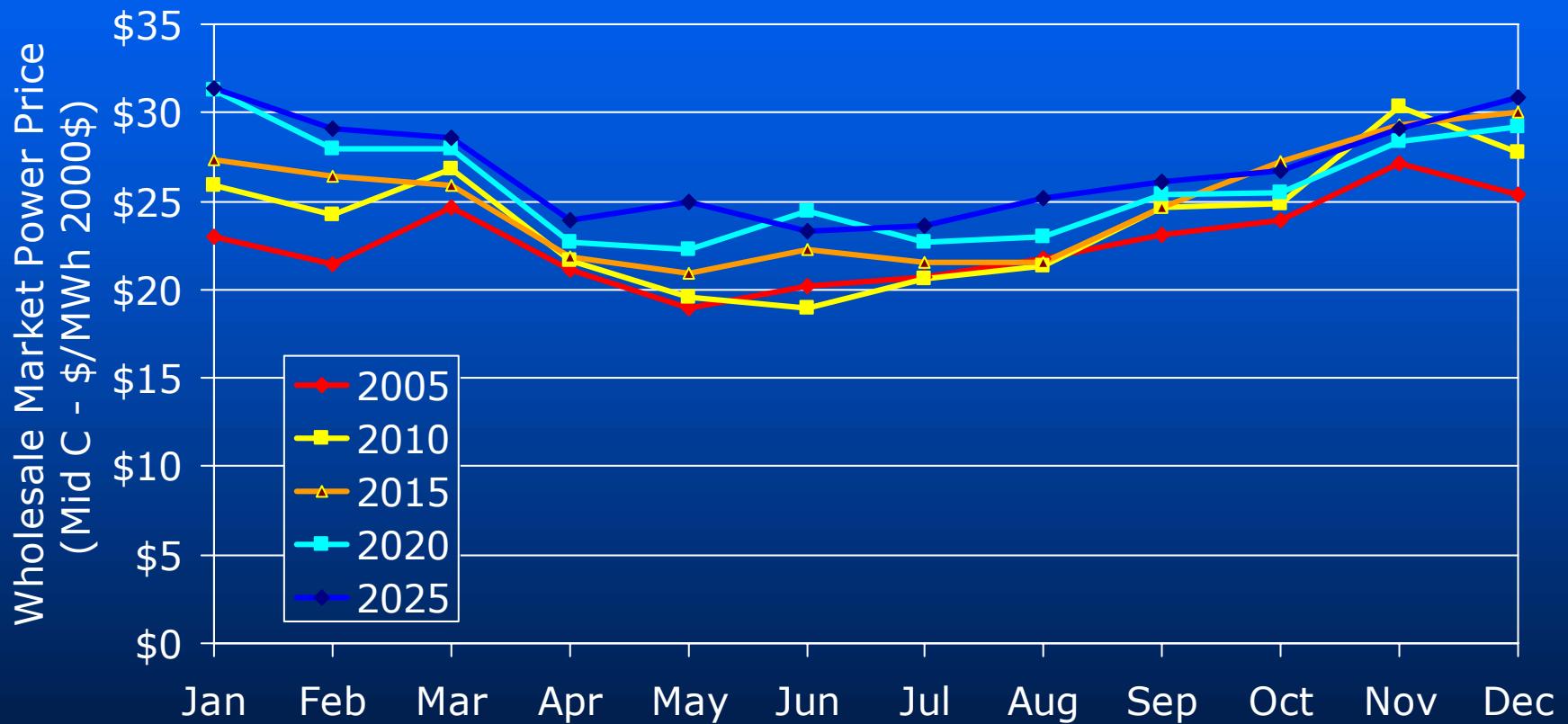
Forecast On-Peak Market Power Prices by Month and Year



Typical Off-Peak Load Profiles



Forecast Off-Peak Market Power Prices by Month and Year



The Council's Conservation's Cost-Effectiveness Analysis Compares Savings with Forecast Market Prices at the time the savings occur

- Four “Load Segments” are used to compute the value of savings:
 - Weekday “Peak” Load Hours
 - Weekday “Ramp Up/Ramp Down” hours and “Weekend Peak” Load Hours
 - Weekday and “Weekend Off-Peak” hours
 - Weekend and Holiday “Very-Low”

Definition of Load Segment Hours									
Hour	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Holiday	
1	3	3	3	3	3	4	4	4	
2	3	3	3	3	3	4	4	4	
3	3	3	3	3	3	4	4	4	
4	3	3	3	3	3	4	4	4	
5	2	2	2	2	2	2	2	4	
6	2	2	2	2	2	2	2	3	
7	2	2	2	2	2	2	2	3	
8	2	2	2	2	2	2	2	3	
9	1	1	1	1	1	2	2	2	
10	1	1	1	1	1	2	2	2	
11	1	1	1	1	1	2	2	2	
12	1	1	1	1	1	2	2	2	
13	1	1	1	1	1	2	2	2	
14	1	1	1	1	1	2	2	2	
15	1	1	1	1	1	2	2	2	
16	1	1	1	1	1	2	2	2	
17	1	1	1	1	1	2	2	2	
18	1	1	1	1	1	2	2	2	
19	2	2	2	2	2	2	2	3	
20	2	2	2	2	2	2	2	3	
21	2	2	2	2	2	2	2	3	
22	2	2	2	2	2	2	2	4	
23	3	3	3	3	3	4	4	4	
24	3	3	3	3	3	4	4	4	

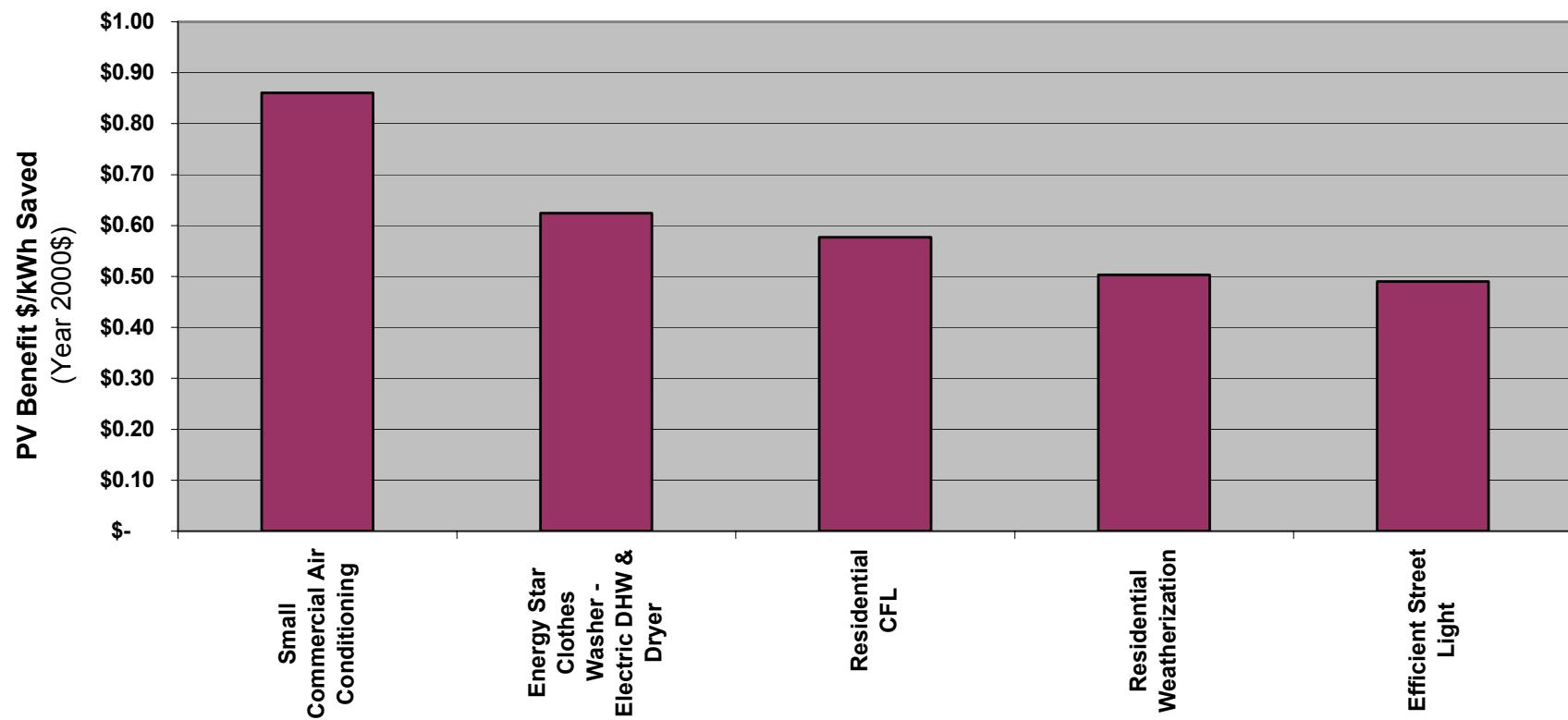
Each Conservation Measure Has a Different “Cost-Effectiveness” Limit Based on When Its Savings Occur



Value Depends on Shape of Savings

Present Value of One kWh Energy Saved Assuming a 20-Year Measure Life

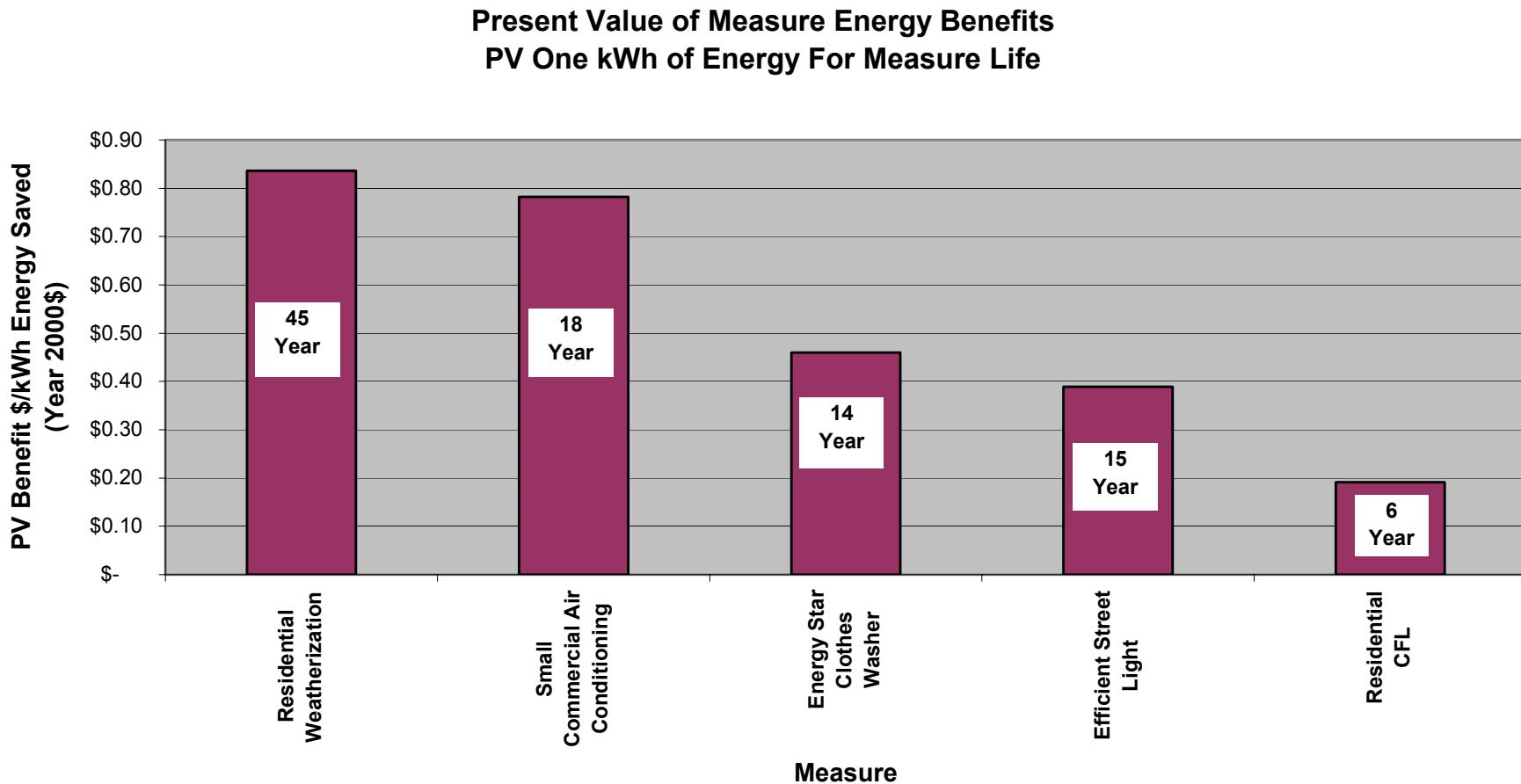
Present Value of Measure Benefits
Assume 20-year Measure Life - Energy Value Only



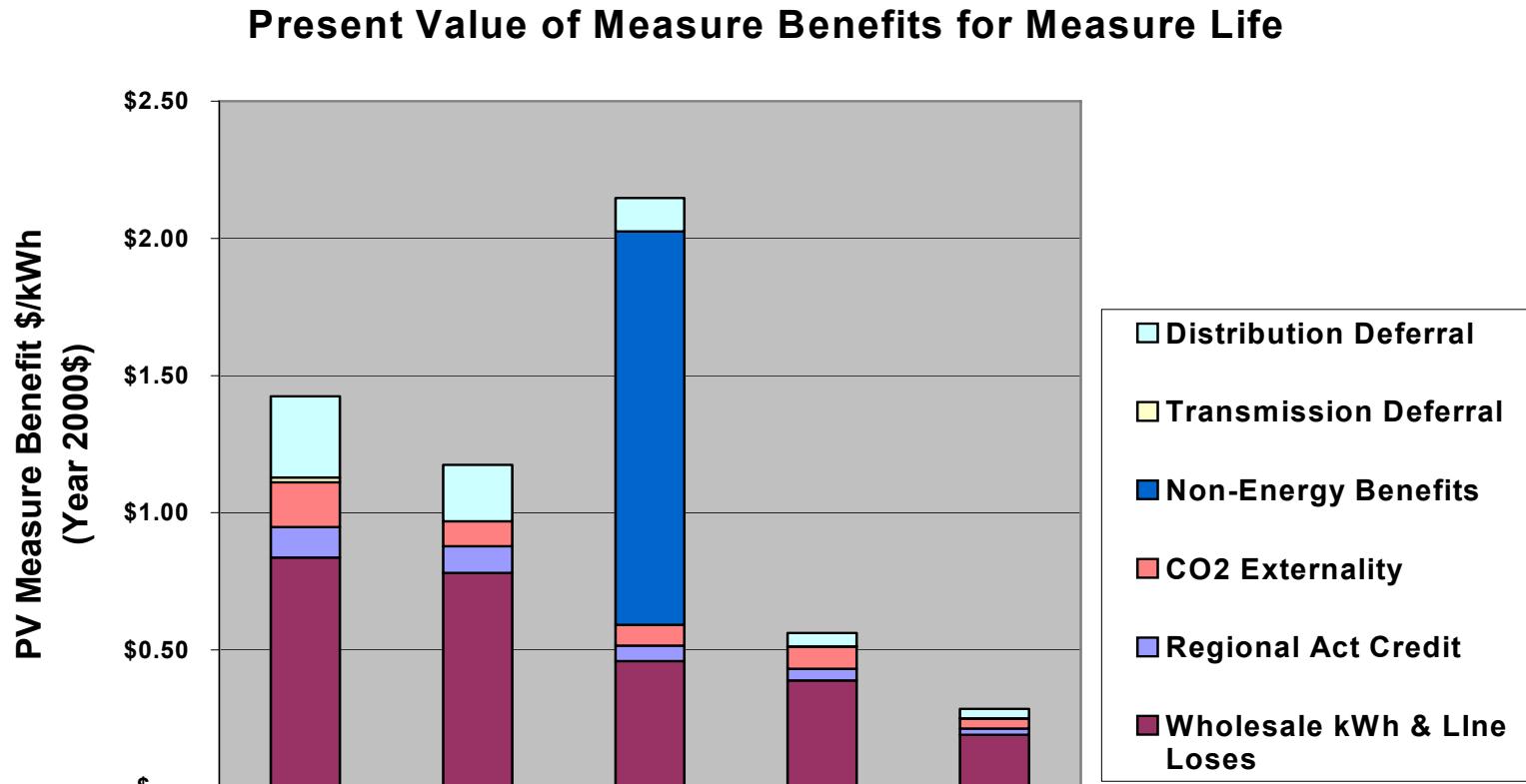
But ...

Longer-Lived Measures Have More Value

Present Value of One kWh Saved
For Life of Measure - Energy Value Only



Present Value of One KWh Saved Considering All Benefits



Benefit/Cost Ratio

B/C Ratio =

$$\frac{\text{Present Value All Benefits}}{\text{Present Value All Costs}}$$

- Incorporates all benefits
 - Shape of saved kWh, life of savings, transmission & distribution deferrals, non-energy benefits, quantifiable externalities
- Incorporates all costs
 - Capital & labor, O&M, periodic replacement, program admin & non-energy costs
 - Regardless of who pays
- Incorporates time value of money for both
- Good when greater than 1.0

Why We Use Benefit/Cost Ratio to Measure Conservation Cost-Effectiveness

- B/C ratio because timing of savings matters
 - There is no single cost against which resources are measured**
 - All resources must now “compete” for development against the West Coast wholesale market price
 - That price varies dramatically by time of day and season of the year
-
- **Levelized cost was useful when we estimated the avoided cost as a single generating plant

Why Cost-Effectiveness?

- Conservation reduces system costs when it is less expensive than alternative supplies
 - The bigger the difference the greater the value
 - No economic benefit to conservation that costs the same as alternative supplies
- Conservation reduces risk relative to some alternatives
 - It carries no risk of fuel or climate change cost
 - Reduces variability of loads
 - Has value even when market prices are low

The Act defines regional cost-effectiveness as follows:

- "Cost-effective", when applied to any measure or resource referred to in this chapter, means that such measure or resource must be forecast to be reliable and available within the time it is needed, and to meet or reduce the electric power demand, as determined by the Council or the Administrator, as appropriate, of the consumers of the customers at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative measure or resource, or any combination thereof." (Emphasis added).

Under the Act the term "system cost" means:

- “An estimate of all direct costs of a measure or resource over its effective life, including, if applicable, the cost of distribution and transmission to the consumer, waste disposal costs, end-of-cycle costs, and fuel costs (including projected increases), and such quantifiable environmental costs and benefits as are directly attributable to such measure or resource”

Act Interpretation

- The Council has interpreted the Act's provisions to mean that in order for a conservation measure to be cost-effective the discounted present value of all of the measure's benefits should be compared to the discounted present value of all of its costs.
- This interpretation was adopted in the Council's 1983 Plan and has not been modified

Why Limit Utility Investments to Cost-effective Measures?

- ***It's Immoral*** – Unless payments are limited by Rate Impact Measure/Test non-participant's rates go up to subsidize others for savings that aren't cost-effective
- ***It's Uneconomic*** – Both the utility system and society could serve the same needs at a lower cost and money spent on non-cost effective measure reduces the amount available to secure these energy services from lower cost options
- ***It's Illegal*** – Bonneville is restricted by the Act and both BPA and the region's utilities are constrained by the Council's model conservation standards for BPA and utility programs

Comparing Costs of Conservation & Alternatives

■ Levelized Cost

- Compare alternatives with different lifetimes & cash flow streams

■ Benefit/Cost Ratio

- Compare stream of benefits & costs
- Use NPV to capture time value of costs & benefits

■ Perspectives

- Total Resource Cost Perspective (TRC)
- Utility Perspective (UPC)
- Bonneville Perspective
- Customer Perspective

Resource Assessment Methods (Availability & Cost)

- Scope of measures
 - Review known measures & practices
 - Over 130 measures & practices 5th Plan
 - New measures (technology)
 - Old measures die (codes supplant some)
- Technical potential is
 - Number of applicable units * Incremental savings per unit

Determine Measure Applicability

Account for territory-specific factors

- Fuel saturations (electric vs gas water heat)
- Building characteristics (size, vintage, insulation)
- Building use (retail, office, school ... single-family, multi-family, mobile home)
- System saturations (heat pump, zonal or gas heat)
- Equipment saturations (36 lamps per house)
- Current measure saturations (4 cfls/house)
- Measure life (stock turnover cycle)
- Measure substitution or overlap (either seal ducts on FAF OR convert FAF to HP and seal ducts)

Determine “Incremental” Savings per Applicable Unit

- Estimated kW & kWh savings
 - By time-of-day, day of week & month of year
- Savings over baseline efficiency
 - Baseline set by codes/standards or current practices
- Climate-sensitive
 - Heating & cooling degree days & solar
- Measure interactions estimated
 - Lighting & HVAC
 - Order of measures applied

Developing Costs

■ Costs

- Materials & labor
 - Financing costs
 - Annual O&M
 - Periodic Replacement
 - Program Admin
 - Externalities
 - Other non-electric
-
- The diagram illustrates the components of developing costs. A vertical line on the left side of the slide is connected by arrows to several descriptive ovals on the right. The first oval at the top contains the text 'From programs, bids, published sources'. The second oval contains 'If financed use sponsor's cost'. The third oval contains 'Lamp & ballast replacement costs'. The fourth oval contains 'Marketing, staff,'.